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FLOOD INSURANCE STUDY

ORIGINAL

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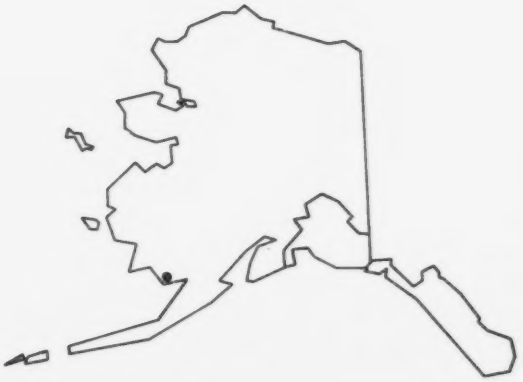
CITY OF DILLINGHAM, ALASKA
BRISTOL BAY DIVISION



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Federal Emergency Management Agency

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TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
1.1	Purpose of Study	1
1.2	Coordination	1
1.3	Authority and Acknowledgments	1
2.0	AREA STUDIED	2
2.1	Scope of Study	2
2.2	Community Description	2
2.3	Principal Flood Problems	4
2.4	Flood Protection Measures	5
3.0	ENGINEERING METHODS	5
3.1	Hydrologic Analyses	6
3.2	Hydraulic Analyses	9
4.0	FLOOD PLAIN MANAGEMENT APPLICATIONS	11
4.1	Flood Boundaries	11
4.2	Floodways	12
5.0	INSURANCE APPLICATION	12
5.1	Reach Determinations	12
5.2	Flood Hazard Factors	12
5.3	Flood Insurance Zones	12
5.4	Flood Insurance Rate Map Description	13
6.0	OTHER STUDIES	15
7.0	LOCATION OF DATA	15
8.0	BIBLIOGRAPHY AND REFERENCES	15

TABLE OF CONTENTS (Cont'd)

Page

FIGURES

Figure 1 - Vicinity Map..... 3

TABLES

Table 1 - Summary of Discharges..... 7
Table 2 - Summary of Elevations..... 8
Table 3 - Flood Insurance Zone Data..... 14

EXHIBITS

Exhibit 1 - Flood Insurance Rate Map Index
Flood Insurance Rate Map

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the City of Dillingham, Bristol Bay Division, Alaska, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Dillingham to the regular program of flood insurance by the Federal Emergency Management Agency. Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

Areas requiring study were identified at a meeting held in Dillingham on November 30, 1978, and attended by representatives of the study contractor, the Federal Emergency Management Agency, and the City of Dillingham. Contact was made by the study contractor with City of Dillingham officials on August 22, 1979. Additional information was solicited at a City Council meeting held on December 6, 1979, and attended by the study contractor.

Interviews with community officials and local residents provided descriptions of historical flooding events. Dillingham does not have a local newspaper, and no accounts of flooding there were found recorded in Anchorage or Fairbanks newspapers. There are no recorded tidal observations for Nushagak Bay. A soils report was obtained from the U.S. Soil Conservation Service. Hourly wind records for Dillingham for the period January 1977 through October 1979 were obtained from the University of Alaska Arctic Environmental Information and Data Center. During the course of the study, contacts were also made with the following agencies: State of Alaska Department of Transportation, the National Ocean Survey, and the National Climatic Center.

The final community coordination meeting was held on September 24, 1981, and was attended by representatives of the Federal Emergency Management Agency, the U.S. Army Corps of Engineers, and the city. The problems presented at this meeting have been resolved.

1.3 Authority and Acknowledgments

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers, Alaska District, for the Federal Emergency Management Agency under Inter-Agency Agreement No. IAA-H-9-79, Project Order No. 2. This work, which was completed in January 1980, covered all significant flooding sources affecting Dillingham.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated areas of the City of Dillingham, Bristol Bay Division, Alaska. The area of study is shown on the Vicinity Map (Figure 1).

The potential flooding sources to be studied in detail were Nushagak River and Wood River along the shoreline of the community. These rivers are subject to the tidal influence of Nushagak Bay.

Squaw Creek and Scandinavian Creek were identified for study by approximate methods along with four other unnamed tributaries.

Those areas studied by detailed methods were chosen with consideration given to all proposed construction and forecasted development through 1985.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by the Federal Emergency Management Agency and the City of Dillingham.

2.2 Community Description

The City of Dillingham is located in southwestern Alaska within the Bristol Bay Division. The city lies at the confluence of Nushagak and Wood Rivers at the head of Nushagak Bay, which is classified as a tidal estuary. Nushagak Bay flows into Bristol Bay approximately 35 miles farther south.

Dillingham is the largest community in this area of western Alaska and is the seat of commercial supply and distribution for the Bristol Bay Division. In 1970, the city had a population of approximately 1000. Dillingham is 350 air miles southwest of Anchorage and 175 air miles southeast of Bethel, but there are no highway connections.

The primary economic base for the community is salmon fishing and processing. The government sector and the transportation and tourism industries are also important components of the city economy.

Most of the developed portions of the community are located on upland knolls, ridges, and rolling hills and are outside flood hazard areas. Where development does occur in flood hazard areas, it is generally limited to the tidal waterfront, the area adjacent to Scandanavian Creek, or to a minor extent, the area adjacent to Squaw Creek. Development along the waterfront consists primarily of port and salmon processing facilities, while along Scandanavian

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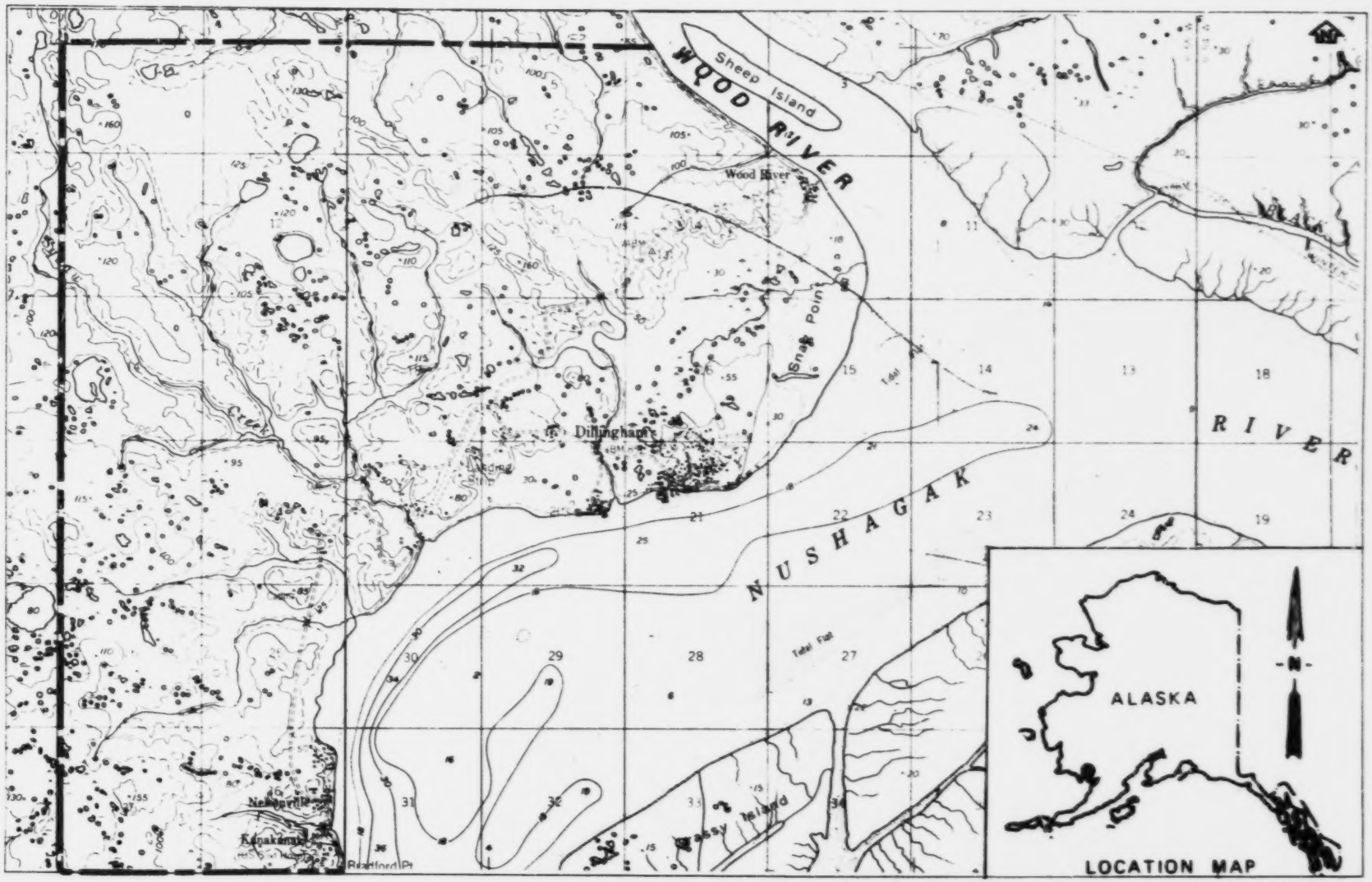

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF DILLINGHAM, AK
(BRISTOL BAY DIVISION)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

Creek there is a variety of limited commercial and industrial development.

The topography in Dillingham is characteristic of areas where deposition by continental glaciers occurred. The land is mostly rolling hills with many irregularly shaped moraine knolls and ridges separated by flat wetlands and muskeg. Elevations range from mean low tide to approximately 170 feet on the higher moraine hills.

The most extensive soils in the region are deep deposits of peat, which occupy nearly all low-lying areas. Silty soils are found on the moraine hills.

Many of the moraine hills are covered with forests of white spruce and paper birch. Other hillsides, generally close to the rivers, support a dense stand of grass and alder with patches of white spruce. On intermediate slopes, mosses and low-growing shrubs are dominant. Plains areas are almost entirely barren of vegetation except for low berry bushes, mosses, and grass.

The climate of Dillingham is transitional in character between maritime and continental. Summers are cool and humid, and winters are moderately cold. Relatively few days have temperatures above 70°F in summer; minimum temperatures are below 0°F for approximately 1 day in 3 in midwinter. Mean annual precipitation is 26 inches, which includes 65 inches of snowfall. Maximum precipitation occurs in late summer and autumn, and the driest period is in early spring. There are many windy days with prevailing winds from the north in winter and from the southwest in summer.

2.3 Principal Flood Problems

Nushagak Bay is connected to Bristol Bay and subject to the influence of tide and wind. The tidal range in Nushagak Bay is approximately 20 feet. Waves generated in Bristol Bay are prevented from reaching Dillingham because Nushagak Bay is broken by scattered islands and mud-bar shallows. However, the region is subject to sudden and violent storms during which locally generated waves can cause shoreline damage.

Documentation of flooding and resulting damages affecting Dillingham is limited. There is no local newspaper, and historical accounts of flooding come from the memories of local residents. There are no tide-gage records on Nushagak Bay.

In general, flooding of Nushagak and Wood Rivers results from a combination of high tides along with strong stormwinds from the south and southwest. These events usually occur in late summer or early fall. More forceful storms may occur during the winter months; however, Nushagak Bay is iced and resistant to wave buildup from September through April of each year.

The worst storm on record at Dillingham reportedly occurred in November 1929 and caused flooding in the lower areas of the city. Events of similar magnitude have reportedly occurred two additional times since then. The dates of occurrence of these floods are not known. The stillwater level reached an elevation of approximately 30 feet on each of these three occasions (Reference 1).

As high tides occur, waves cut into the toe of the bluff fronting the city and cause significant erosion. From local testimony, the bank line is receding at a rate of 2 to 10 feet per year due to undercutting and sloughing.

Coastal flooding may also be caused by tsunamis (seismic sea waves). However, no known tsunami record is indicated for the Bristol Bay area (Reference 2).

There is no history of flooding on any of the six tributary streams, other than that due to tidal influence or water backup at culverts. No damage has resulted from such occurrences.

2.4 Flood Protection Measures

There are no protection measures against either tidal or riverine flooding or erosion in the City of Dillingham.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance premium rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equalled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual occurrence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported here reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

Riverine

Because of the proximity of Dillingham to the Nushagak Bay estuary, Nushagak River in the study reach is subject to permanent tidal influence, and riverine flooding is an insignificant source. As this type of relationship is not apparent for Wood River, a floodflow frequency analysis was carried out to determine whether or not noncoincident riverine flooding exceeds tidal flooding levels.

Flow frequency data for the Wood River at Aleknagik gage (Station 15-3030) were taken from Reference 3. These data are based on 14 years of record at the U.S. Geological Survey gage and computed using log-Pearson Type III frequency analysis and the latest U.S. Water Resources Council Guidelines. Flood magnitudes for recurrence intervals of up to 25 years are published in Flood Characteristics of Alaskan Streams (Reference 3). The points were plotted on log-probability paper and graphically extrapolated to determine flows of greater return frequencies. The drainage area tributary to the study reach is approximately 24 percent greater than the area above the gage. Therefore, the floodflow frequency data established for the gage site were adjusted upward by the method described in Flood Characteristics of Alaskan Streams (Reference 3) to account for the additional drainage area.

Analyses were carried out to establish the peak elevation-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail affecting the community.

Peak discharge-drainage area relationships for Wood River are shown in Table 1.

The 100-year peak discharges for the six streams studied by approximate methods were estimated using multiple-regression equations (Reference 3).

Floodflows used in this study result from runoff from rain or snowmelt and do not include floods caused by backwater due to ice jams or by channel icing (aufeis).

Elevations for floods of the selected recurrence intervals on Nushagak Bay are shown in Table 2.

Table 1. Summary of Discharges

Flooding Source and Location	Drainage Area (Square Miles)	Peak Discharges (Cubic Feet per Second) 10-Year	50-Year	100-Year	500-Year
Wood River					
Near Mouth	1,360	22,800	30,000	32,900	---[1]

[1]Data Not Available

Table 2. Summary of Elevations

Flooding Source and Location	Elevation (Feet) 10-Year	50-Year	100-Year	500-Year
Nushagak Bay				
Reach 1 (At the Confluence of Scandinavian Creek and Nushagak River)	28.9	31.2	32.1	33.8
Reach 2	33.6	39.6	41.8	46.1
Reach 3	28.9	31.2	32.1	33.8

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Coastal

Flood damage in coastal areas is a result of high stillwater levels and wave action. The stillwater level is controlled by astronomical tide, caused by gravitational effects of the sun and the moon, and by storm surge, the rise in water level due to wind stress and low atmospheric pressure. In addition, wave action produces a rise in water level due to shoreward mass transport of the water, called wave setup. After breaking, wave runup can also produce flooding, while the energy of the wave can cause damage above the stillwater level of the flood.

There are minimal amounts of data available for developing a stillwater frequency curve for Dillingham. There are no tide gage records for Nushagak Bay, nor could such data be obtained for the gage in the Dillingham small-boat harbor. The only reported high-water marks occurred in 1929 and on two unspecified dates since then, with stillwater reaching an approximate elevation of 30 feet on each occasion (Reference 1). Local residents report that stillwater gets up to an elevation of 24 feet each year. The stillwater frequency curve was developed from this information and is assumed to represent the combined effects of astronomical tide, storm surge, and wave setup. For this study, no attempt was made to do a separate analysis of any of the three stillwater components.

A wind rose for the Dillingham airport was obtained by the study contractor (Reference 4). Additional hourly wind data were obtained through the University of Alaska (Reference 5). A frequency analysis for winds from the southwest and southeast was performed using the hourly data for the June through October ice-free period. However, these data did not represent a long enough period of record to produce windspeeds consistent with residents' observations. The data were therefore adjusted upward to produce a wind frequency curve felt to be more realistic.

3.2 Hydraulic Analyses

Riverine

Analyses of the hydraulic characteristics of the flooding sources studied in the community were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

For Wood River, a stage-discharge relationship was developed for coincident riverine flows in the study reach. This analysis indicated that riverine flows produce lesser changes in water-surface elevation than do tidal influences. This showed that coastal events are the predominant source of flooding in the study area. Therefore, no further riverine hydraulic computations were made, and no floodway was delineated. Flood hazards for Wood River were determined as part of the coastal analysis.

The elevations for the 100-year approximate areas were determined using the determined discharges in conjunction with aerial photographs (Reference 6).

Coastal

Hydraulic analyses of the shoreline characteristics of the flooding sources studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of the shorelines.

For detailed coastal study areas, the effects of high stillwater levels and wave runup were combined to determine the maximum flood elevations. Wave prediction and wave runup calculations were performed by methods described in the U.S. Army Corps of Engineers Shore Protection Manual (Reference 7) and Coastal Engineering Technical Aid No. 78-2 (Reference 8).

Wind-wave computations were performed using the hourly wind frequency curves for southwest and southeast winds. Deep-water waves do not occur at Dillingham because of the shallow waters of Nushagak Bay. Bathymetric data from the nautical chart for Nushagak Bay (Reference 9) were used with the shallow-water wave forecasting curves in the Shore Protection Manual (Reference 7) to estimate wave heights associated with expected winds. For this analysis, it was assumed that wind waves of a specified return frequency occur simultaneously with a storm surge of the same probability as the same meteorological conditions produce both.

Because of shallow waters, mud bars, and limited fetch length in Nushagak Bay, refraction has little effect on wave energy. Consideration of shoaling and refraction was therefore not undertaken for this study.

The entire detailed study area was broken into three reaches based on differences in beach slope. Beach slopes were scaled from the 2-foot contour maps (Reference 10). Reach locations are shown on the Flood Insurance Rate Map (Exhibit 1). Calculation methods specified in Coastal Engineering Technical Aid 78-2 (Reference 8) were used to compute wave runup for both the significant and the 1-percent wave. The appropriate value of runup due to the significant wave was added to the stillwater level to obtain the elevations shown in Table 2. Effective beach slope and wave-breaking height may vary dramatically in a relatively short distance along the shoreline. Therefore, two adjacent reaches may have 100-year flood elevations that vary by more than 1 foot. The combination of stillwater and 1-percent wave runup is used to delineate the boundary of the special flood hazard areas shown on the Flood Insurance Rate Map (Exhibit 1).

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The approximate 100-year tidal areas were studied utilizing estimated 100-year stillwater elevations.

All elevations are referenced to Mean Lower Low Water Datum (MLLW). Elevation reference marks used in the study are shown on the maps.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage State and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

For each coastal area studied in detail, the boundaries of the 100- and the 500-year floods have been delineated by considering ground contours and water-surface elevations or depths. Areas inundated by the 100-year flood that have additional hazards due to wave action also have been delineated. In cases where the 100- and the 500-year flood boundaries are close together, only the 100-year boundary has been shown. In detailed study areas, the flood boundaries have been delineated by plotting the elevations previously determined on topographic maps at a scale of 1:1200, with a contour interval of 2 feet (Reference 10).

Approximate flood boundaries were estimated based on inspection of aerial photographs (Reference 6) and topographic maps (Reference 11). The boundaries were verified through a field survey.

Flood boundaries are indicated on the Flood Insurance Rate Map (Exhibit 1). On this map, the 100-year flood boundary corresponds to the boundary of the areas of special flood hazards (Zones A6, A16, V6, and V16); and the 500-year flood boundary corresponds to the boundary of the areas of moderate flood hazards (Zone B). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year flood boundary has been shown. Small areas within the flood boundaries may lie above the flood elevations and, therefore, not be subject to flooding; owing to limitations of the map scale, such areas are not shown.

The flood boundaries shown on the Flood Insurance Rate Map (Exhibit 1) are for conditions existing at the time of this report. As a result of erosion and accretion, the flood boundaries may change in the future.

4.2 Floodways

The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment in order that the 100-year flood be carried without substantial increases in flood heights. No floodways were determined in this study because the flooded area is under permanent tidal influence.

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the Federal Emergency Management Agency has developed a process to transform the data from the engineering study into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source studied in detail affecting Dillingham.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses or water bodies having relatively the same flood hazard. In tidal areas, reaches are limited to the distance for which the 100-year flood elevation does not vary more than 1.0 foot. Using these criteria, three reaches were required for the flooding sources of Dillingham. The locations of these reaches are shown on the Flood Insurance Rate Map (Exhibit 1).

5.2 Flood Hazard Factors

The FHF is the Federal Emergency Management Agency device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHF are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest one-half foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of Dillingham was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

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Zone V:	Special Flood Hazard Areas along coasts inundated by the 100-year flood, as determined by approximate methods, and that have additional hazards due to velocity (wave action); no base flood elevations shown or FHFs determined.
Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones V6 and V16:	Special Flood Hazard Areas along coasts inundated by the 100-year flood, as determined by detailed methods, and that have additional hazards due to velocity (wave action); base flood elevations shown, and zones subdivided according to FHFs.
Zones A6 and A16:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood, including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding.

The flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are summarized in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for Dillingham is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1% (100-YEAR) FLOOD AND			FLOOD HAZARD FACTOR	ZONE	BASE FLOOD ELEVATION FEET (MLLW)[3]
		10% (10-YEAR)	2% (50-YEAR)	0.2% (500-YEAR)			
Nushagak Bay							
Reach 1	0016,0017	-3.2	-0.9	1.7	030	V6,A6	32
Reach 2	0017	-8.2	-2.2	4.3	080	V16,A16	42
Reach 3	0017	-3.2	-0.9	1.7	030	V6,A6	32

[1]Flood Insurance Rate Map Panel [2]Weighted Average [3]Rounded to Nearest Foot

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF DILLINGHAM, AK
(BRISTOL BAY DIVISION)

FLOOD INSURANCE ZONE DATA

NUSHAGAK BAY

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show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the Federal Emergency Management Agency.

6.0 OTHER STUDIES

The only existing flood study work for Dillingham is the Flood Hazard Boundary Map (Reference 12). This Flood Insurance Study was performed using more detailed engineering methods and, therefore, supersedes all previous determinations.

This study is authoritative for the purposes of the National Flood Insurance Program; data presented herein either supersede or are compatible with all previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Federal Regional Center, 130 228th Street, SW., Bothell, Washington 98011.

8.0 BIBLIOGRAPHY AND REFERENCES

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